

Newark Bay/Lower Passaic River In Situ Bioremediation Pilot Study Work Plan

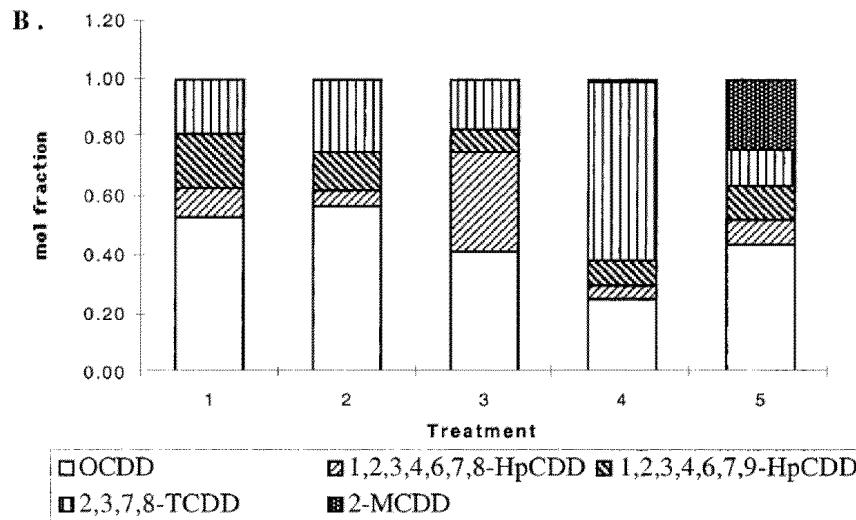
John Pardue, LSU

Donna Fennell, Rutgers

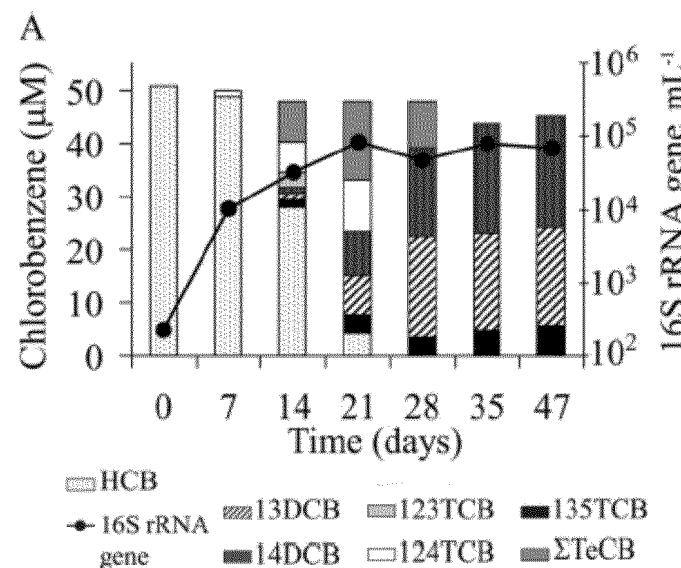
Outline

- Rationale
- Goal & Objectives
- Academic Team
- Science Advisory Board
- Study Sites
- Experimental Units
- Predesign Studies
- Treatments
- Measurements
 - Chemical analytes
 - Supporting measurements in academic laboratories

Rationale



Dioxin dechlorination activity can be stimulated in the Passaic, Albrecht et al., 1999



Dhc present in river sediments and linked to HCB dechlorination, Tas et al., 2011

Reductive dehalogenation of chlorinated dioxins by an anaerobic bacterium

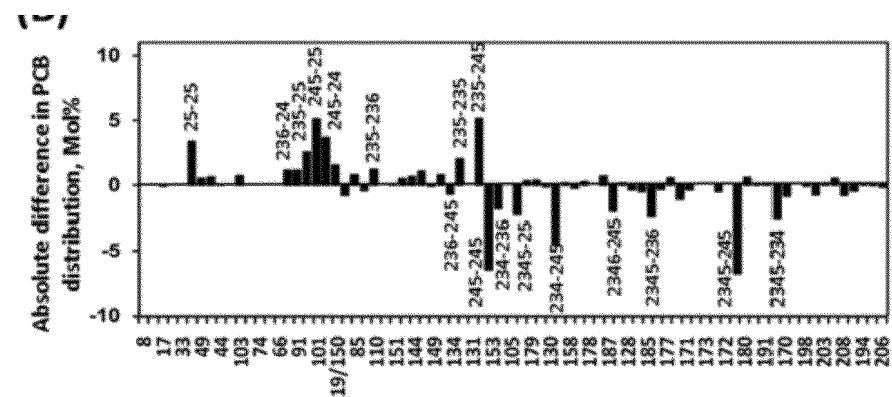
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Germany

Dhc degrade dioxins, 2003



Dhc can demonstrate dechlorination activity towards PCBs, Wang et al., 2013

Pilot Study Goal & Objectives

PILOT STUDY GOAL:

To demonstrate in-situ bioremediation as a viable and effective remediation technology for Newark Bay and LPR sediments.

PILOT STUDY OBJECTIVES:

- To enhance the populations of dehalorespiring microorganisms in sediments of Newark Bay and the LPR
- To measure temporal changes in PCB and dioxin congeners, DDT and metabolites and PAHs in defined sections of Newark Bay and LPR sediments undergoing bioremediation.
- To causally connect changes in PCB and dioxin concentrations with actions that enhance Newark Bay and LPR sediment dehalorespiring populations.
- To determine the impact of these bioremediation processes on other contaminants of concern actions in Newark Bay and LPR sediments including mercury.
- To develop reliable procedures for addition of carbon amendments and microbial cultures in river experimental caissons in sediments and shallow bay sediments

LPR Academic Team

- Dr. John Pardue, Louisiana State University
(field study and biogeochemistry/biodegradation)
- Dr. Donna Fennell, Rutgers University
(microbial characterization, dioxin dechlorination)
- Dr. Danny Reible, Texas Tech University
(SPME monitoring of porewater)
- Dr. Lily Young, Rutgers University
(PAH degradation)
- Dr. Andrew Jackson, Texas Tech University
(Dialysis sampling of porewater)
- Dr. John Reinfelder, Rutgers University
(Hg chemistry)

Science Advisory Board

- A esteemed group of scientists and engineers with expertise in areas to include bioremediation, microbial ecology, sediments and metal chemistry will be appointed to advise the LPR Academic Team on the conduct of the study.

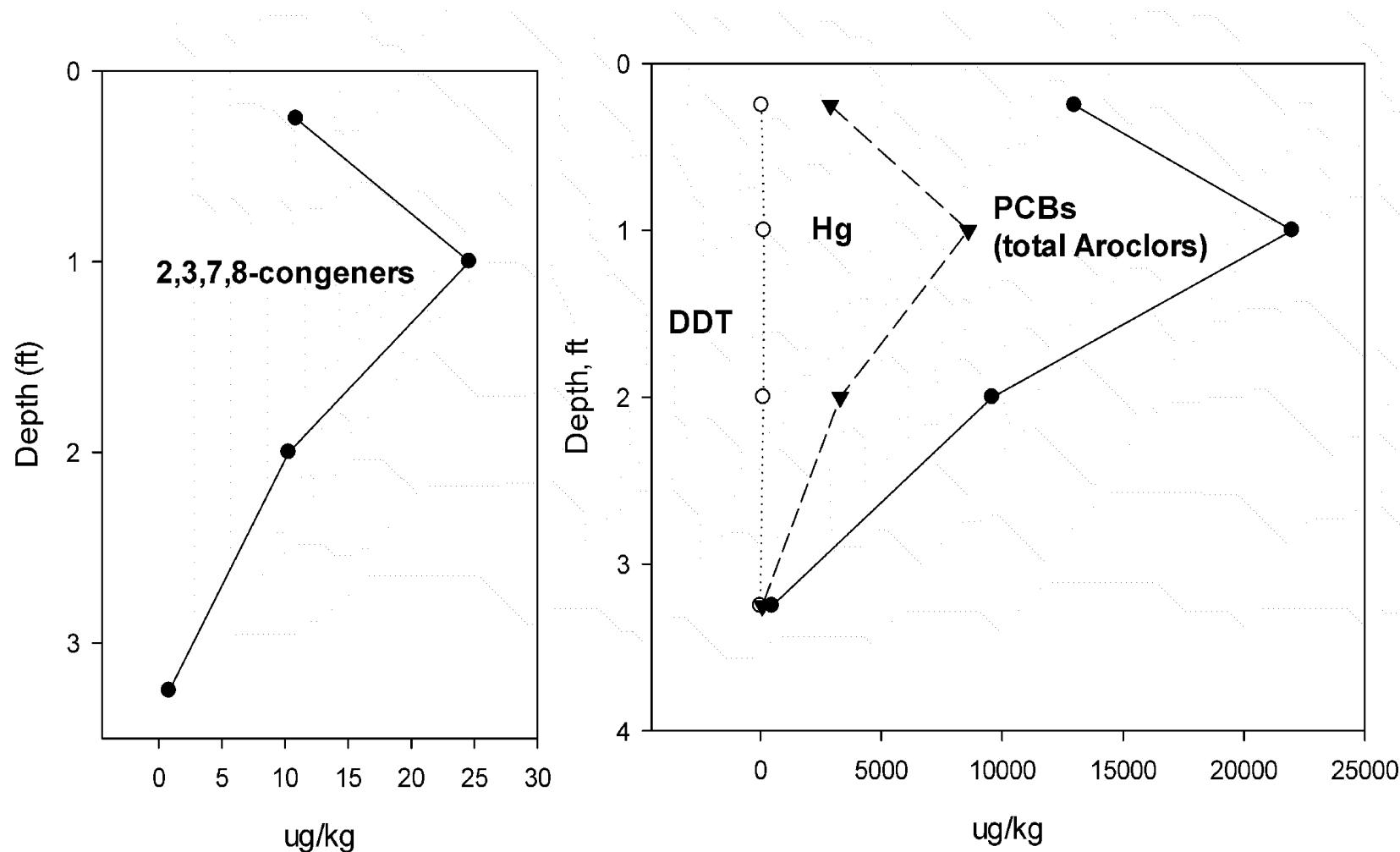
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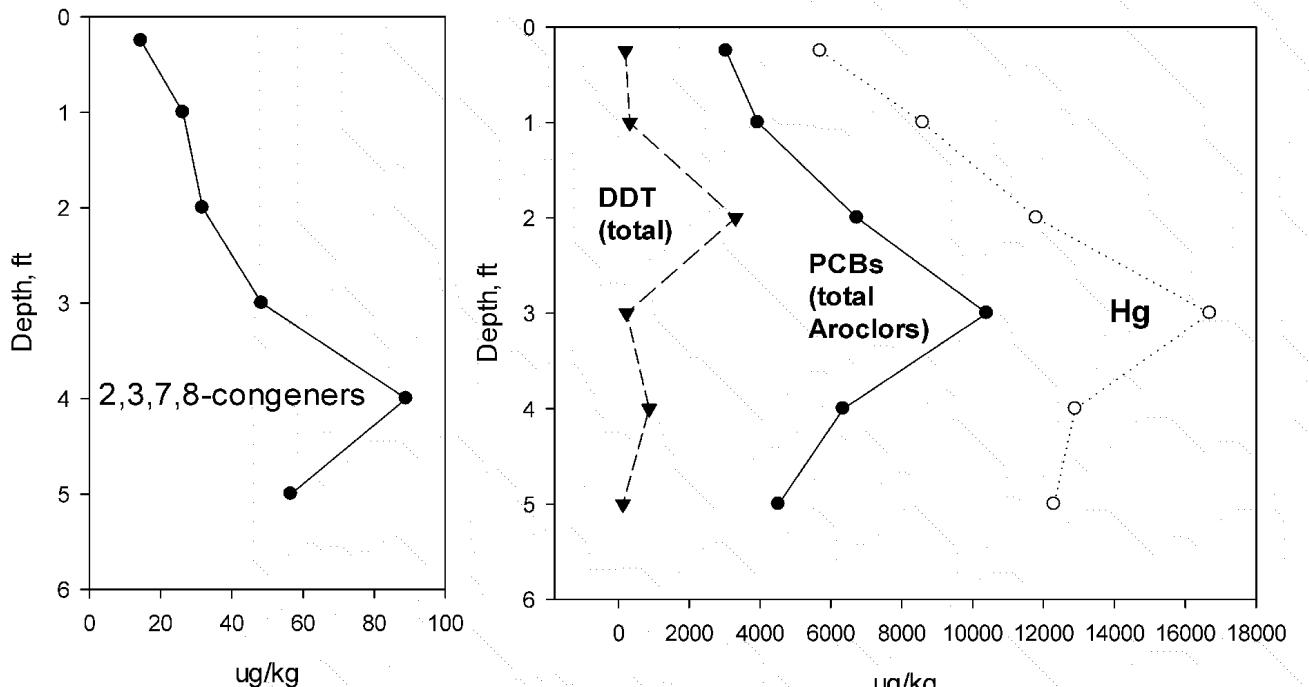
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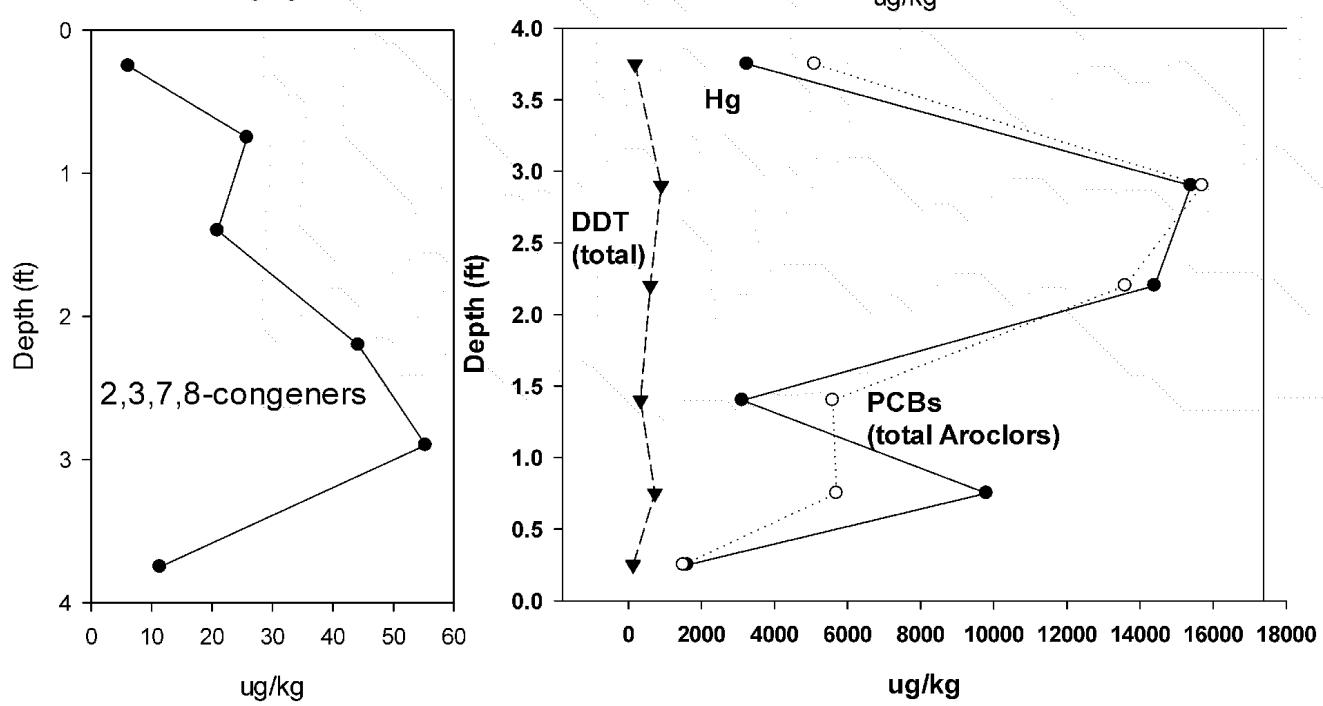
Google earth

Proposed Site S1

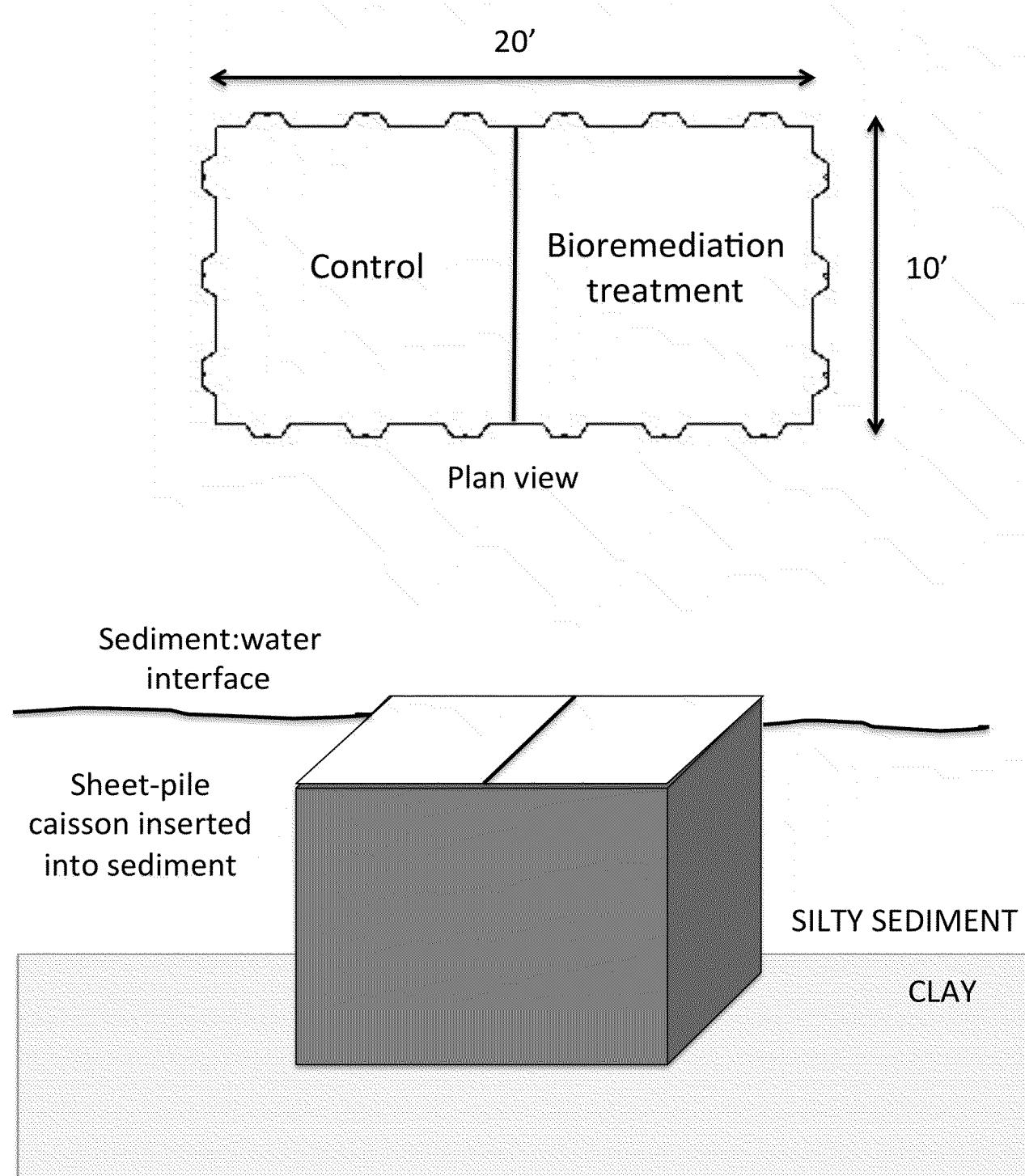


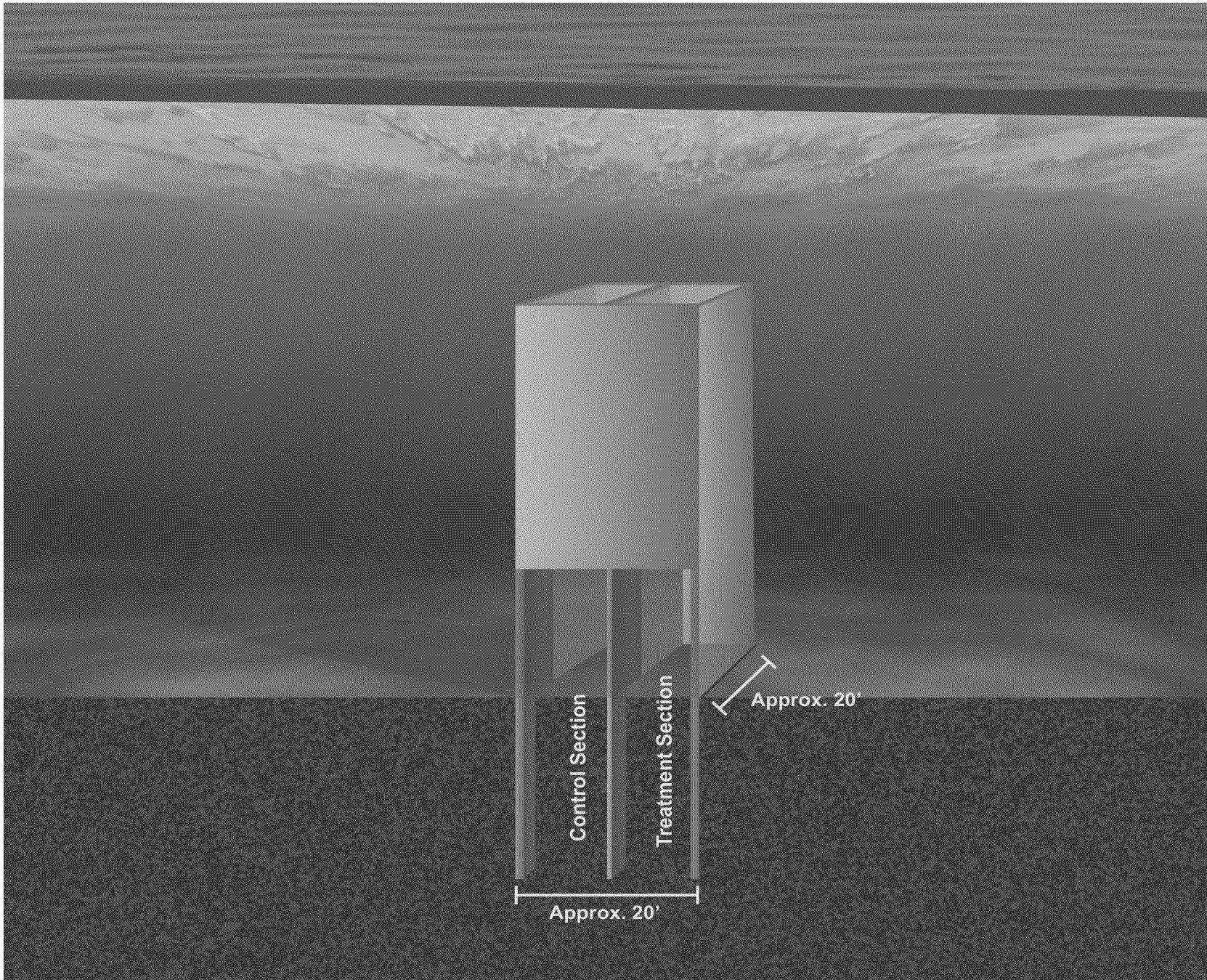


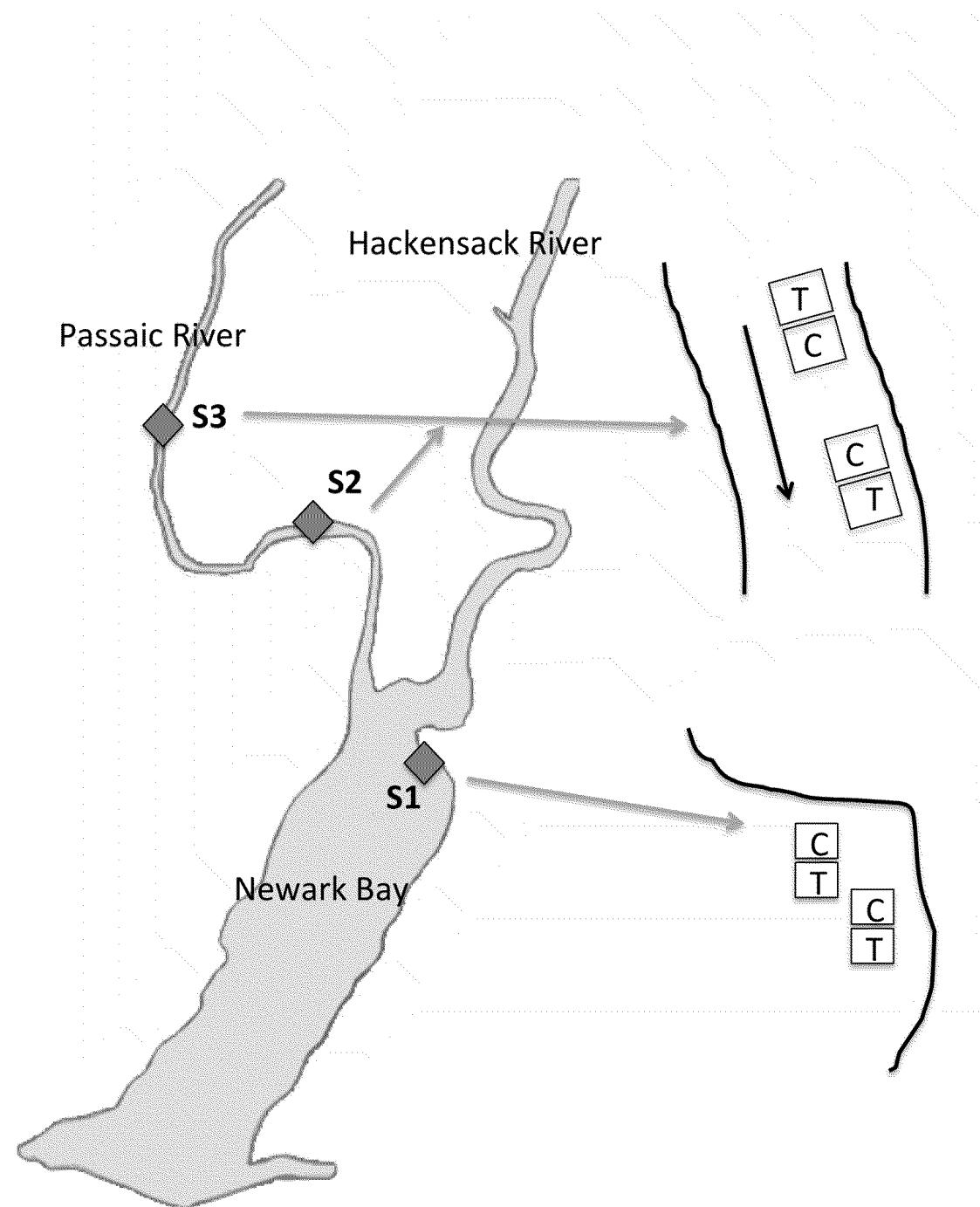
S2



S3





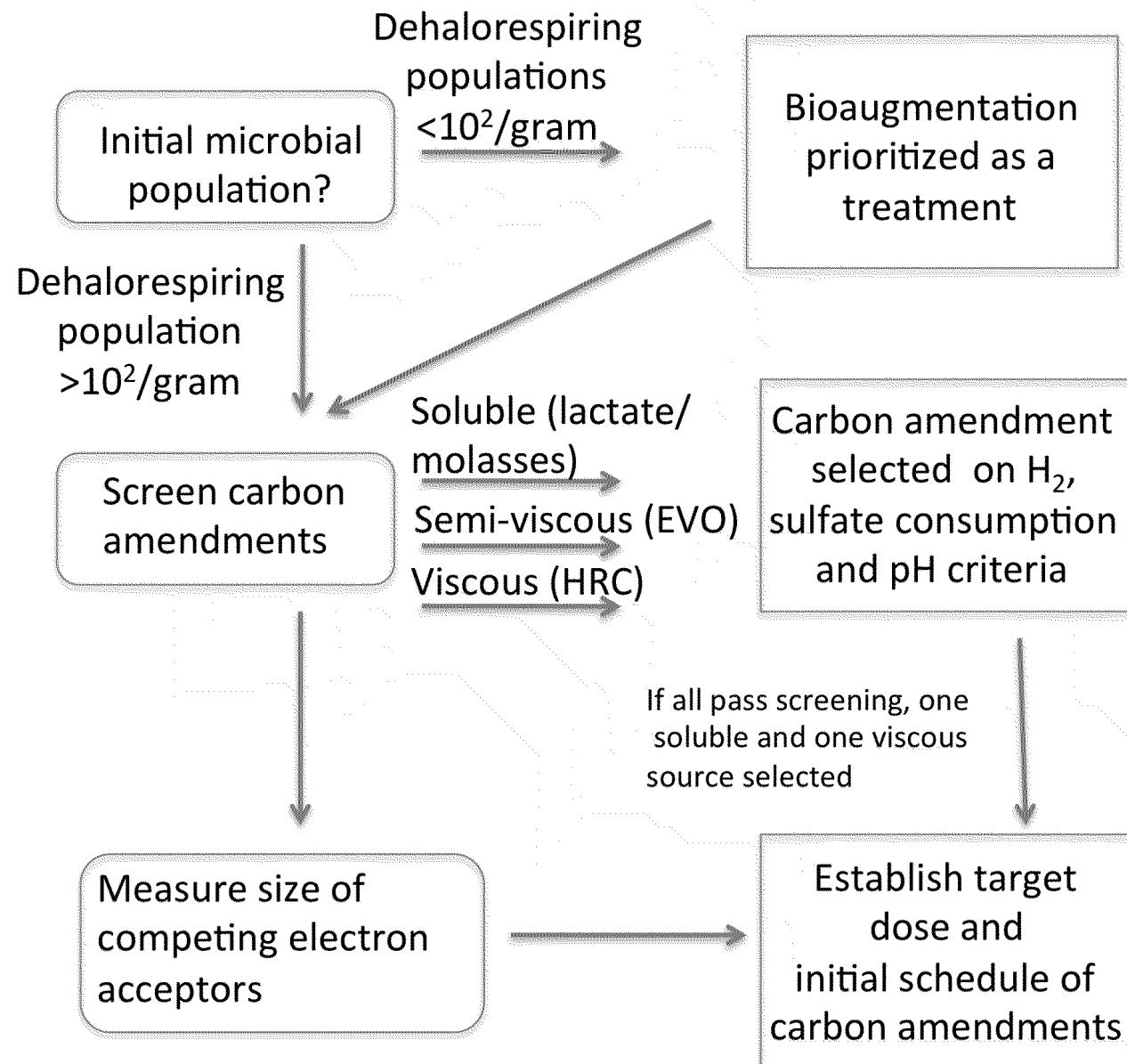


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Candidate carbon donors to be screened

Category	Carbon Source	Dose Range
Soluble	Lactate (as sodium lactate)	50-300 mg/L
Soluble	Molasses (as 5% by weight diluted in H ₂ O)	50-500 mg/L
Low-viscosity	Emulsified vegetable oil	100-500 mg/L
Viscous	HRC-X™	100-500 mg/L



Treatments

- One caisson with carbon amendments only
- One caisson with carbon amendments plus an added microbial population
 - Development of a “Passaic” dioxin and PCB degrading culture will accompany the initial portion of the study

Chemical analytes for mass balance construction

Parameter ¹	Caisson experimental units ²	Cores removed per sampling event ³	Sampling depths ⁴	Sampling Frequency ⁵
PCDD/Fs	12	3	3	Quarterly
PCB Congeners	12	3	3	Quarterly
Pesticides	12	3	3	Semiannually
Chlorinated herbicides	12	3	3	Semiannually
Metals	12	3	3	Quarterly
Semivolatiles	12	3	3	Semiannually
Methylmercury	12	3	3	Quarterly

¹ EPA methods or equivalent. Details provided in project-specific QAPP

²See Figure 5

³2" vibracores

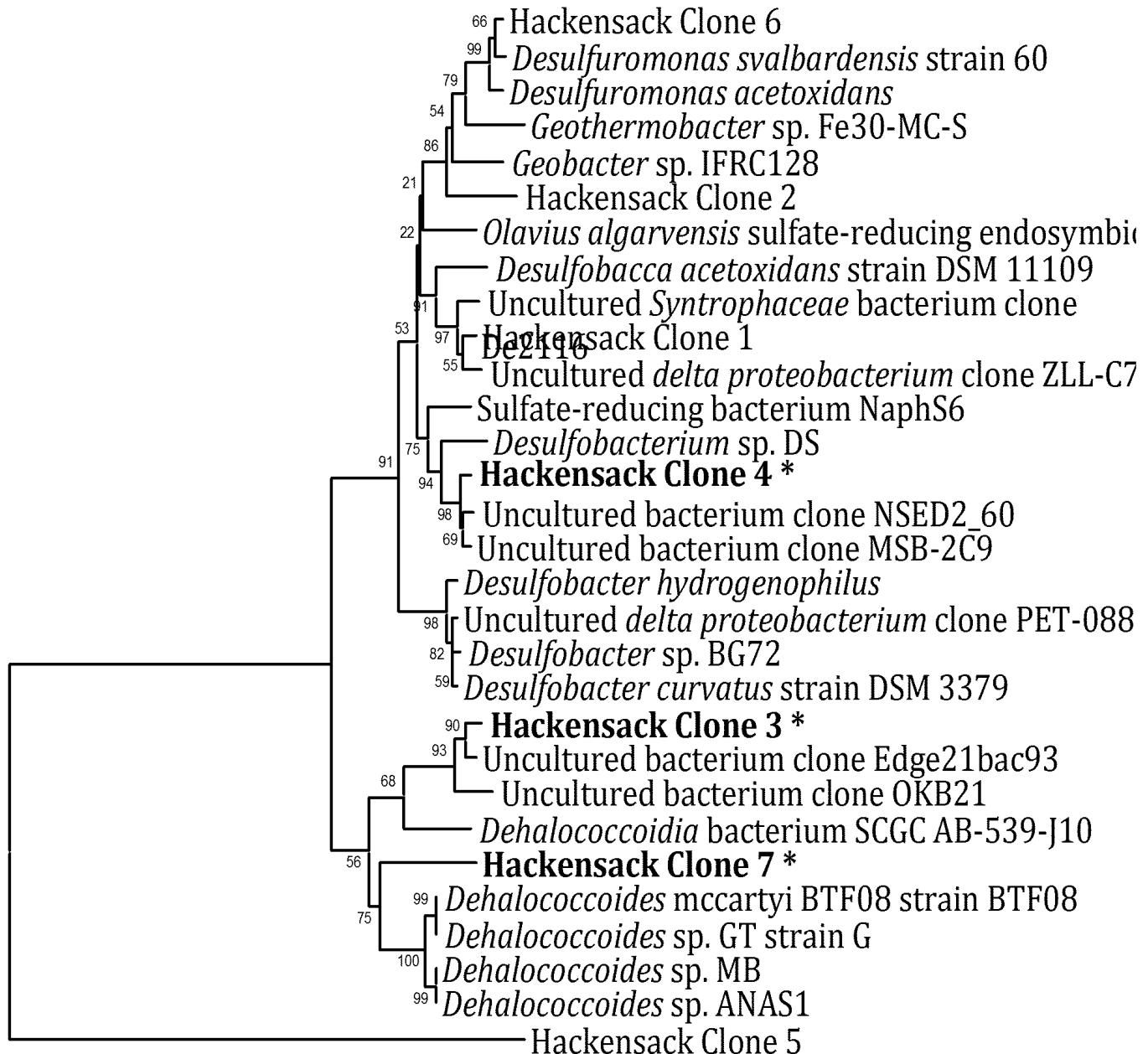
⁴0-0.5', 0.5-2' and 2-4' composites

⁵ All analytes will also have time zero samples with the same replicate subsamples

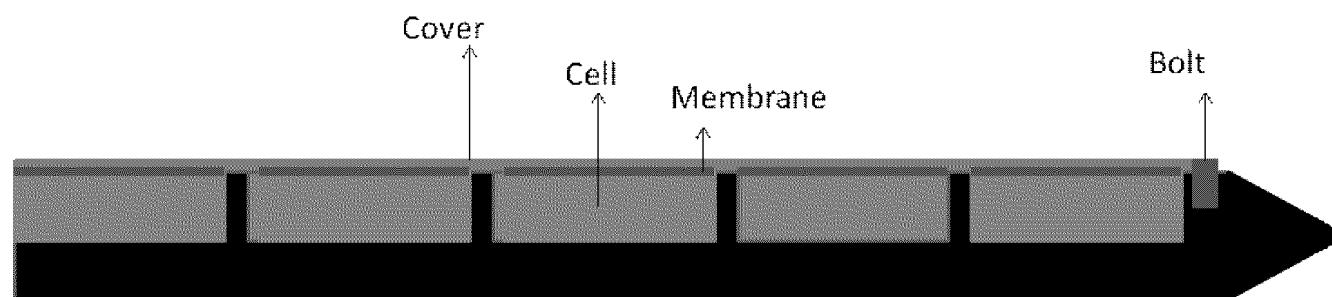
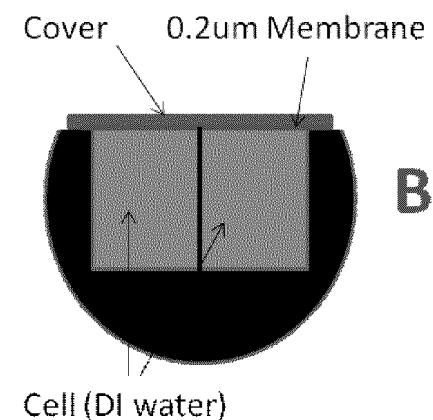
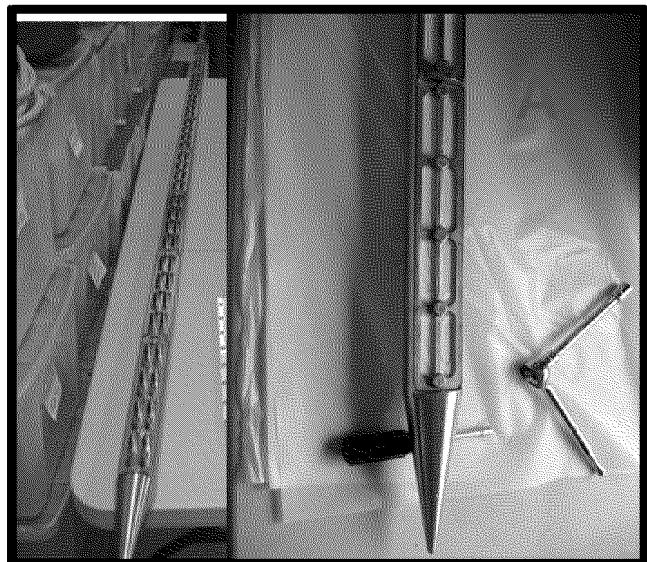
⁶Method modified to quantitate, 2-monochlorodibenzodioxin, 2,7-monochlorodibenzodioxin and 2,7,8-trichlorodibenzodioxin

Supporting field study measurements from academic partners

Measurement approach	Analytes	Frequency	Laboratory
Changes in geochemical conditions			
Dialysis sampler	Sulfate, methane, organic acids, ammonium, orthophosphate, conductivity	Quarterly	Dr. Andrew Jackson, Texas Tech Univ. Dr. John Pardue Louisiana State University
Mercury speciation			
Mercury speciation	Total Hg, Methylmercury and non-cinnabar (HgS) mercury	Semiannually	Dr. John Reinfelder Rutgers University
Microbial Community Analysis			
Quantitative microarray	Dhc, Dhb, <i>Dehalogenimonas</i> spp. (Dhg), <i>Desulfitobacterium</i> spp. (DSB), <i>Dehalobium chlorocoercia</i> (DECO), <i>Desulfuromonas</i> spp. (DSM)	Quarterly	Microbial Insights, Knoxville, TN
Stable isotope probing	Measurement of actively dechlorinating microbial population	Semiannually	Dr. Donna Fennell, Rutgers
Functional genes	PAH and aromatic degrading and dechlorination functional genes	Semiannually	Dr. Lily Young, Rutgers Dr. Donna Fennell, Rutgers
Bioavailability of CoCs in sediment porewater			
Passive sampling via PDMS and DGT	PCBs and dioxins, PAHs and Hg	Semiannually	Dr. Danny Reible, Texas Tech University



0.1



Stainless-steel Dialysis samplers

ESTIMATED PILOT STUDY TIME LINE

(July 28, 2014)

1) Design/Contracting/ Procurement

Sept.
2014

Nov.
2014

2) Caisson Fabrication & Installation

Dec.
2014

Jan.
2015

3) Pilot Study

Feb.
2015

Jul.
2016

4) Demob. & Write Final Pilot Study Report

Aug.
2016

Sept.
2016

2014

Sep

Pilot Study
Start
Feb. 2015

Dec

2015

Mar

Interim Pilot Study
Report
Sept. 2015

Jun

Sep

Dec

2016

Mar

Pilot Study Ends
Jul. 2016

Jun

Sep

By Sept. 30, 2014
U.S. EPA Approval
of Pilot Study Work
Plan

Sept. 2016

Final Pilot Study Report
Submitted to U.S. EPA



Questions?